

**THAT WHICH IS CLAIMED:**

1. A method for the production of a composition comprising:
  - (a) admixing: 1) a liquid, 2) a zinc-containing compound, 3) a silica-containing material, 4) alumina, and 5) a promoter so as to form a mixture thereof;
  - 5 (b) drying said mixture so as to form a dried mixture;
  - (c) calcining said dried mixture so as to form a calcined mixture;
  - (d) reducing said calcined mixture with a suitable reducing agent under suitable conditions to produce a composition having a reduced  
10 valence promoter content therein, and
  - (e) recovering said composition.
2. A method in accordance with claim 1 wherein said calcined mixture is reduced in step (d) such that said composition will effect the removal of sulfur from a stream of hydrocarbons when such stream is contacted with same under desulfurization conditions.
3. A method in accordance with claim 1 wherein said promoter comprises a metal selected from the group consisting of nickel, cobalt, iron, manganese, copper, zinc, molybdenum, tungsten, silver, tin, antimony, vanadium, gold, platinum, ruthenium, iridium, chromium, palladium, titanium,  
5 zirconium, rhodium, rhenium, and combinations of any two or more thereof.

4. A method in accordance with claim 3 wherein said promoter comprises nickel.

5. A method in accordance with claim 1 wherein said silica-containing material is in the form of crushed expanded perlite.

6. A method in accordance with claim 1 wherein said mixture from step (a) is in the form of one of a wet mix, dough, paste, or slurry.

7. A method in accordance with claim 6 wherein said mixture from step (a) is in the form of a slurry.

8. A method in accordance with claim 1 wherein said mixture from step (a) is particulated prior to said drying in step (b).

9. A method in accordance with claim 1 wherein said mixture from step (a) is particulated in the form of one of granules, extrudates, tablets, spheres, pellets, or microspheres prior to said drying in step (b).

10. A method in accordance with claim 1 wherein said mixture from step (a) is particulated by spray drying in step (b) so as to form said dried mixture.

11. A method in accordance with claim 1 wherein said mixture is dried in step (b) at a temperature in the range of from about 65.5°C to about 550°C.

12. A method in accordance with claim 1 wherein said dried mixture is calcined in step (c) at a temperature in the range of from about 204.4°C to about 815.5°C.

13. A method in accordance with claim 1 wherein said calcined mixture is reduced in step (d) at a temperature in the range of from about 37.8°C to about 815.5°C and at a pressure in the range of from about 15 to about 1500 psia and for a time sufficient to permit the formation of a reduced valence promoter.

14. A method in accordance with claim 1 wherein during said calcining of step (c) at least a portion of said alumina is converted to an aluminate.

15. A composition produced by the process of claim 1.

16. A method for the production of a composition comprising:

- (a) admixing: 1) a liquid, 2) a metal-containing compound, 3) a silica-containing material, 4) alumina, and 5) a first promoter so as to form a mixture thereof;
- 5 (b) drying said mixture so as to form a dried mixture;
- (c) incorporating a second promoter onto or into said dried mixture to form an incorporated mixture;
- (d) drying said incorporated mixture so as to form a dried incorporated mixture;
- 10 (e) calcining said dried incorporated mixture so as to form a calcined incorporated mixture;

(f) reducing said calcined incorporated mixture with a suitable reducing agent under suitable conditions to produce a composition having a reduced valence promoter content therein; and

15 (g) recovering said composition.

17. A method in accordance with claim 16 wherein said first promoter comprises a metal selected from the group consisting of nickel, cobalt, iron, manganese, copper, zinc, molybdenum, tungsten, silver, tin, antimony, vanadium, gold, platinum, ruthenium, iridium, chromium,  
5 palladium, titanium, zirconium, rhodium, rhenium, and combinations of any two or more thereof.

18. A method in accordance with claim 16 wherein said first promoter comprises nickel.

19. A method in accordance with claim 16 wherein said calcined incorporated mixture is reduced in step (f) such that said composition of step (g) will effect the removal of sulfur from a stream of hydrocarbons when such stream is contacted with same under desulfurization conditions.

20. A method in accordance with claim 16 wherein said metal-containing compound comprises a metal selected from the group consisting of zinc, manganese, silver, copper, cadmium, tin, lanthanum, scandium, cerium, tungsten, molybdenum, iron, niobium, tantalum, gallium,  
5 indium, and combinations of any two or more thereof.

21. A method in accordance with claim 20 wherein said metal-containing compound comprises zinc.

22. A method in accordance with claim 16 wherein said second promoter is comprised of at least one metal selected from the group consisting of nickel, cobalt, iron, manganese, copper, zinc, molybdenum, tungsten, silver, tin, antimony, vanadium, gold, platinum, ruthenium, iridium, chromium,  
5 palladium, titanium, zirconium, rhodium, rhenium, and combinations of any two or more thereof.

23. A method in accordance with claim 22 wherein said second promoter comprises nickel.

24. A method in accordance with claim 16 wherein said silica-containing material is present in the form of crushed expanded perlite.

25. A method in accordance with claim 16 wherein said mixture from step (a) is in the form of one of a wet mix, dough, paste, or slurry.

26. A method in accordance with claim 25 wherein said mixture from step (a) is in the form of a slurry.

27. A method in accordance with claim 16 wherein said mixture from step (a) is particulated prior to drying in step (b).

28. A method in accordance with claim 16 wherein said mixture from step (a) is particulated in the form of one of granules, extrudates, tablets, spheres, pellets, or microspheres.

29. A method in accordance with claim 16 wherein said mixture from step (a) is particulated by spray drying in step (b) so as to form said dried mixture.

30. A method in accordance with claim 16 wherein said mixture and said incorporated mixture are each dried in steps (b) and (e), respectively, at a temperature in the range of from about 65.5°C to about 550°C.

31. A method in accordance with claim 16 wherein said dried incorporated mixture is calcined in step (e) at a temperature in the range of from about 204.4°C to about 815.5°C.

32. A method in accordance with claim 16 wherein the reduction of said calcined incorporated mixture in step (g) is carried out at a temperature in the range of from about 37.4°C to about 815.5°C and at a pressure in the range of from about 15 to about 1500 psia and for a time  
5 sufficient to permit the formation of a reduced valence promoter.

33. A method in accordance with claim 16 wherein during said calcining in step (e) at least a portion of said alumina is converted to an aluminate.

34. A method in accordance with claim 16 wherein said dried mixture from step (b) is calcined prior to said incorporating of step (c).

35. A method in accordance with claim 34, wherein said dried mixture is calcined at a temperature in the range of from about 204.4°C to about 815.5°C.

36. A composition produced by the process of claim 16.

37. A process for the removal of sulfur from a hydrocarbon stream comprising:

- (a) contacting said hydrocarbon stream with a composition produced by the process of claim 1 in a desulfurization zone under conditions such that there is formed a at least partially desulfurized hydrocarbon stream and a sulfurized composition;
- (b) separating said at least partially desulfurized hydrocarbon stream from said sulfurized composition thereby forming a separated desulfurized hydrocarbon stream and a separated sulfurized composition;
- 10 (c) regenerating at least a portion of said separated sulfurized composition in a regeneration zone so as to remove at least a portion of the sulfur contained therein and/or thereon thereby forming a regenerated composition;
- (d) reducing said regenerated composition in a reduction zone  
15 so as to provide a reduced composition having a reduced valence promoter content therein which will effect the removal of sulfur from sulfur-containing hydrocarbons when contacted with same; and thereafter
- (e) returning at least a portion of said reduced composition to said desulfurization zone.

38. A process in accordance with claim 37 wherein said hydrocarbon stream comprises a fuel selected from the group consisting of cracked-gasoline, diesel fuel, and combinations thereof.

39. A process in accordance with claim 37 wherein said desulfurization in step (a) is carried out at a temperature in the range of from about 37.8°C to about 537.8°C and a pressure in the range of from about 15 to about 1500 psia for a time sufficient to effect the removal of sulfur from said  
5 stream.

40. A process in accordance with claim 37 wherein said regeneration in step (c) is carried out at a temperature in the range of from about 37.8°C to about 815.5°C and a pressure in the range of from about 10 to about 1500 psia for a time sufficient to effect the removal of at least a portion  
5 of the sulfur from said separated sulfurized composition.

41. A process in accordance with claim 37 wherein air is employed in step (c) as a regeneration agent in said regeneration zone.

42. A process in accordance with claim 37 wherein said regenerated composition from step (c) is subjected to reduction with hydrogen in step (d) in said reduction zone which is maintained at a temperature in the range of from about 37.8°C to about 815.5°C and at a pressure in the range of  
5 from about 15 to about 1500 psia and for a period of time sufficient to effect a reduction of the valence of the promoter content of said regenerated composition.



43. A process in accordance with claim 37 wherein said separated sulfurized composition from step (b) is stripped prior to introduction into said regeneration zone in step (c).

44. A process in accordance with claim 37 wherein said regenerated composition from step (c) is stripped prior to introduction to said reduction zone in step (d).

45. The cracked-gasoline product of the process of claim 38.

46. The diesel fuel product of the process of claim 38.

47. A process for the removal of sulfur from a hydrocarbon stream comprising:

(a) contacting said hydrocarbon stream with a composition produced by the process of claim 16 in a desulfurization zone under conditions  
5 such that there is formed a desulfurized hydrocarbon stream and a sulfurized composition;

(b) separating said desulfurized hydrocarbon stream from said sulfurized composition thereby forming a separated desulfurized hydrocarbon stream and a separated sulfurized composition;

10 (c) regenerating at least a portion of said separated sulfurized composition in a regeneration zone so as to remove at least a portion of the sulfur contained therein and/or thereon thereby forming a regenerated composition;

(d) reducing said regenerated composition in an activation zone  
15 so as to provide a reduced composition having a reduced valence promoter  
content therein which will effect the removal of sulfur from a hydrocarbon  
stream when contacted with same; and thereafter

(e) returning at least a portion of said reduced composition to  
said desulfurization zone.

48. A process in accordance with claim 47 wherein said  
hydrocarbon stream comprises a fuel selected from the group consisting of  
cracked-gasoline, diesel fuel, and combinations thereof.

49. A process in accordance with claim 47 wherein said  
desulfurization in step (a) is carried out at a temperature in the range of from  
about 37.8°C to about 537.8°C and a pressure in the range of from about 15 to  
about 1500 psia for a time sufficient to effect the removal of sulfur from said  
5 stream.

50. A process in accordance with claim 47 wherein said  
regeneration in step (c) is carried out at a temperature in the range of from  
about 37.8°C to about 815.5°C and a pressure in the range of from about 10 to  
about 1500 psia for a time sufficient to effect the removal of at least a portion  
5 of the sulfur from said separated sulfurized composition.

51. A process in accordance with claim 47 wherein air is  
employed in step (c) as a regeneration agent in said regeneration zone.

52. A process in accordance with claim 47 wherein said regenerated composition from step (c) is subjected to reduction with hydrogen in step (d) in said reduction zone which is maintained at a temperature in the range of from about 37.8°C to about 815.5°C and at a pressure in the range of  
5 from about 15 to about 1500 psia and for a period of time sufficient to effect a reduction of the valence of the promoter content of said regenerated composition.

53. A process in accordance with claim 47 wherein said separated sulfurized composition from step (b) is stripped prior to introduction into said regeneration zone in step (c).

54. A process in accordance with claim 47 wherein said regenerated composition from step (c) is stripped prior to introduction to said reduction zone in step (d).

55. The cracked-gasoline product of the process of claim 48.

56. The diesel fuel product of the process of claim 48.